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EXHIBIT D

(English Annotation)

MEMORANDUM

February 8, 2001

To: Mr. Guizeng SHI

Request for Seal

Please seal the enclosed Declaration and Assignment for filing a foreign patent application and return the same to us as soon as possible.

社内連絡票

H13年2月8日

宛先(事業場名) Tb 殿	0463-40 発信 内線 (5553) 企画管理部 技術管理課	責任者 村田	担当 名嶋
★下記の件について 連絡. 報告. 手配. 実施. 検討. 依頼. 照会. 回答. 借用. 返却. 送付 します (願います)。		添付書類 なし あり (枚)	
<p>件 名 捺印のお願い</p> <p>外国出願の手続を行う関係上、添付の委任状の氏名右横に捺印の上、</p> <p>(月 日 ()) までに 技術管理課 名嶋 までご返送ください。</p> <p>↓ 至急!!</p> <p>その他書類も至急ご返送下さい。</p> <p style="text-align: right;">以 上</p>			

送信ページ数は 02 ページです。

USA
ASSIGNMENT OF PATENT APPLICATION

- (1) Guizhen
- (2) _____
- (3) _____
- (4) _____
- (5) _____

In consideration of the sum of one dollar (\$1.00) and other good and valuable consideration paid to each of the undersigned, the undersigned agree(s) to assign, and hereby does assign, transfer and set over to

- (6) MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
- (6a) of 1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8501 JAPAN
- (7) _____
- (7a) of _____

(hereinafter designated as the Assignee) the entire rights, title and interest for the United States, its territories, dependencies and possessions, and for the country of

- (8) _____ in the invention, and all applications for patent and any Letters Patent which may be granted therefor, known as

- (9) COMMUNICATION TERMINAL APPARATUS, BASE STATION APPARATUS
AND RADIO COMMUNICATION METHOD (Case No. _____)

for which the undersigned has (have) executed on even date herewith an application for patent in the United States of America or, if not on even date, then has executed

- (10) on _____ or has already filed
- (11) U.S. appln. Serial No. 09/701,309, filed on November 28, 2000

- (12) The undersigned acknowledges an obligation of assignment of this invention to said assignee at the time the invention was made.

1) The undersigned agree(s) to execute all papers necessary in connection with the application and any continuing or divisional applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient.

2) The undersigned agree(s) to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation or division thereof and to cooperate with the Assignee in every way possible in obtaining such evidence and going forward with such interference.

3) The undersigned agree(s) to execute all papers and documents and perform any act which may be necessary in connection with claims or provisions of the International Convention for Protection of Industrial Property or similar agreements.

4) The undersigned agree(s) to perform all affirmative acts which may be necessary to obtain a grant of a valid United States patent to the Assignee.

5) The undersigned hereby authorize(s) and request(s) the Commissioner of Patents to issue any and all Letters Patent of the United States resulting from said application or any division or divisions or continuing applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has (they have) full right to convey the entire interest herein assigned, and that he has (they have) not executed and will not execute, any agreement in conflict herewith.

6) The undersigned hereby grant(s) the firm of STEVENS, DAVIS, MILLER & MOSHER, L.L.P. the power to insert on this assignment any further identification which may be necessary or desirable to comply with the rules of the United States Patent Office for recordation of this document.

In witness whereof, executed by the undersigned on the date(s) opposite the undersigned signature(s).

Date _____ Signature of Inventor (1) _____ (Seal)

Date _____ Signature of Inventor (2) _____ (Seal)

Date _____ Signature of Inventor (3) _____ (Seal)

Date _____ Signature of Inventor (4) _____ (Seal)

Date _____ Signature of Inventor (5) _____ (Seal)

This assignment should preferably be signed before: (a) a Notary Public if within the U.S.A., or (b) a U.S. Counsel if outside the U.S.A. If neither, then it should be signed before at least two witnesses who also sign here:

Date _____ Signature of Witness _____ (Seal)

Date _____ Signature of Witness _____ (Seal)

**APPLICATION FOR UNITED STATES PATENT
Declaration for Patent Application**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on

the invention entitled: COMMUNICATION TERMINAL APPARATUS, BASE STATION APPARATUS AND RADIO COMMUNICATION METHOD

the specification of which 2 (file no. _____)

(check at least one) 3 ☐ is attached hereto
4 ☒ was filed on 11/28/2000 as (5) U.S. Application Serial No. 09/701,309
6 ☐ and was amended _____
(if applicable)

Use this portion only if you are entering the U.S. National phase based on a PCT International Application designating the U.S.

7 ☒ was filed as PCT international application
8 Number PCT/JP00/01754
9 on March 23, 2000
and was amended under PCT Article(s) 19 and/or 34
10 on _____ (if applicable).
11 priority date claimed in PCT International Application

<u>JAPAN</u> (Country)	<u>JP11-094351</u> (Number)	<u>31/March/1999</u> (Day/Month/Year Filed)
<u>JAPAN</u> (Country)	<u>JP11-102734</u> (Number)	<u>9/April/1999</u> (Day/Month/Year Filed)
_____ (Country)	_____ (Number)	_____ (Day/Month/Year Filed)

I hereby declare that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended, by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me which is material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date earlier than that of the application(s) on which priority is claimed.

Prior (Foreign) Application(s) any Priority Claims Under 35 U.S.C. 119			Priority Claimed	
12a	_____ (Country)	_____ (Number)	_____ (Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
	_____ (Country)	_____ (Number)	_____ (Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No

Priority Claim(s) from U.S. Provisional Application(s) – I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

12b	Application No.	Day/Month/Year Filed	Application No.	Day/Month/Year Filed
	_____	_____	_____	_____

<small>Do not use this portion to identify a PCT application if the parent application is the U.S. National phase of the PCT application</small>	I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between filing date of the prior application and the national or PCT international filing date of this application.		
	13	_____ (U.S. Application Number)	_____ (U.S. Filing Date)

I hereby appoint the following attorneys of the firm of Stevens, Davis, Miller & Mosher, L.L.P. as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent and Trademark Office:

James E. Ledbetter, Reg. No. 28732; Thomas P. Pavelko, Reg. No. 31689; and Anthony P. Venturino, Reg. No. 31674.

**ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO
STEVENS, DAVIS, MILLER & MOSHER, L.L.P., 1615 L Street, N.W., Suite 850, Washington, D.C. 20036,
TELEPHONE (202) 408-5100, FACSIMILE (202) 408-5200.**

See page 2 for signature lines

INSTRUCTIONS FOR COMPLETION OF THIS FORM

line 1 Insert the same title as is used on the specification and in the assignment.

line 2 Is optional but is provided so that you can use it to identify more readily an application prior to the time that the Patent Office application serial number is assigned. We suggest that the specification, drawings and declaration always bear a file number since it can help to get the papers together in case they become inadvertently separated. In instances where the specification is filed without a signed declaration form (under 37 CFR §1.53) a file number on a later-received separate form will assist us in associating it with the correct case.

line 3 Check this box if the specification, claims and drawing (if any) are attached to this declaration form, e.g., when filing a new patent application.

lines 4-5 Are only used in an instance where the application is already on file and the declaration form is being separately filed, e.g., when the application was originally filed without a signed declaration or where the Patent Office has required a new declaration because of a deficiency in the original declaration. In such an instance the Patent Office will require that lines 4 and 5 be completed with the filing date and application serial number already assigned.

line 6 Is used in conjunction with line 5 but only when there have been one or more amendments to the specification or claims. Line 6 is also used when the Examiner requires a new declaration because claims inserted by amendment cover subject matter not originally claimed (37 CFR §1.67).

lines 7-11 Are for PCT (Patent Cooperation Treaty) cases and are used only when you are entering the U.S. National phase (Chapter I or II) based upon a previously filed PCT International application designating the U.S.

line 7 Check this box if this is a PCT National Phase application.

line 8 Insert PCT International application number.

line 9 Insert date of filing of PCT International application.

lines 10-11 Insert the date of all amendments filed in the PCT International application. Such amendments are optional, so this line at times will not be used.

line 12a Is used in the following instances:

(i) If a single priority is being claimed from a foreign application you need to list only the first-filed application; you do not need to list other countries if all applications were filed within one year of the U.S. filing.

(ii) If multiple priorities are being claimed, from a plurality of applications filed in one or more countries, you must list the first filed application for each aspect of the invention. Example: if aspect A of the invention was disclosed in an application filed 11 months earlier in country X and aspect B was disclosed 9 months earlier in an application filed in country Y, then the applications in both countries X and Y must be identified. Only the first application for each aspect of the invention needs to be identified provided all applications on that aspect were filed within one year prior to the U.S. filing.

(iii) If a non-priority application is being filed you must list all applications in all countries where corresponding foreign applications were filed more than one year prior to the U.S. filing. This is so the Examiner can check to see if any of those applications were published or patented early enough to be prior art against the U.S. application.

(iv) If there are more than two applications to be listed we suggest that you type in on this form only "See attached Schedule A" and then list all of the previous applications on an attached sheet.

line 12b Is used to claim priority under 35 USC §119(e) based on a provisional application filed within one year of the filing of the instant application. More than one provisional application may be identified provided neither was filed more than one year earlier.

line 13 This block is used only in instances where there is a previously filed U.S. non-provisional application which was copending at the time the present application was (or is being) filed. That previous application could be a U.S. non-provisional application or the National Phase of a PCT allocation. In such a case the present application may be entitled to the priority of the previous application's U.S. filing date (and consequently the foreign priority thereof) provided the present application is identified as a continuing application (continuation, divisional or continuation-in-part) of the earlier (parent) application. If the foregoing is applicable, please fill in one line for each such prior application.

line 14 Type the inventor's proper legal name in the order specified, e.g., "John B. JONES" or "J. Bob JONES" if the inventor so prefers. It is not acceptable to use only initials such as "J. B. JONES."

line 15 The inventor's "signature" may be his (or her) usual manner of signing but it is preferable that the inventor simply write his (or her) name in his (or her) own cursive handwriting in the same order as on line 14, e.g., given name, middle initial and Family name.

line 16 Insert the actual date of signature.

line 17 Insert simply the city and state or country, e.g., "Paris, France", of the inventor's residence, not citizenship. No street address or postal code is required on this line.

line 18 Insert the inventor's citizenship. The statement of citizenship (or subject of) is a statutory requirement (35 USC §115). Simply the name of the country of citizenship, e.g., "Japan" is sufficient.

line 19 Insert the inventor's mailing address. The purpose of requiring the post office address is to enable the Patent Office to communicate directly with the inventor if desired, such as in the case of death of the U.S. attorney. It should be the address where the inventor customarily receives his (or her) mail and should include the postal code. If applicable it can be the inventor's business address or address at place of employment.

Applicants are reminded that the U.S. Patent and Trademark Office has very strict requirements as to proper execution of an application. The applicant should make sure that he reviews the declaration, prior to signing to make sure the declaration properly identifies the application and all relevant information; and should review the specification and claims (including drawings, if any) before signing the declaration. Failure to do so will require the filing of a supplemental declaration --- 37 CFR §1.67(c).

Any handwritten changes to the specification, claims or drawings must be in ink personally by all of the inventors prior to signing the declaration and the adjacent left margin must be initialed and dated by all of the inventors, e.g., "JB 6-9-91".

Please let us know if there are any questions regarding proper completion of this form. Thank you.

An assignment, a separate document requiring separate signature and dating may be enclosed. Please look for it and sign and date it in the same manner as in lines 15 and 16 above.

STEVENSON, DAVIS, MILLER & MOSHER, L.L.P.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

PAGE 2 OF U.S.A. DECLARATION FORM

14a	Typewritten Full Name of Sole or First Inventor	Guizeng	SHI	
		Given Name	Middle Name	Family Name
15a	Inventor's Signature			
16a	Date of Signature	Month	Day	Year
17a	Residence	Akishima-shi	Tokyo	JAPAN
		City	State or Province	Country
18a	Citizenship	JAPAN		
19a	Post Office Address (Insert complete mailing address, including country)	4-4-18-104, Midori-cho,		
		Akishima-shi, Tokyo 196-0004 JAPAN		
14b	Typewritten Full Name of Sole or First Inventor			
		Given Name	Middle Name	Family Name
15b	Inventor's Signature			
16b	Date of Signature	Month	Day	Year
17b	Residence	City	State or Province	Country
18b	Citizenship			
19b	Post Office Address (Insert complete mailing address, including country)			
14c	Typewritten Full Name of Sole or First Inventor			
		Given Name	Middle Name	Family Name
15c	Inventor's Signature			
16c	Date of Signature	Month	Day	Year
17c	Residence	City	State or Province	Country
18c	Citizenship			
19c	Post Office Address (Insert complete mailing address, including country)			
14d	Typewritten Full Name of Sole or First Inventor			
		Given Name	Middle Name	Family Name
15d	Inventor's Signature			
16d	Date of Signature	Month	Day	Year
17d	Residence	City	State or Province	Country
18d	Citizenship			
19d	Post Office Address (Insert complete mailing address, including country)			

*Note to Inventor: Please sign name on line 15 exactly as it appears in line 14 and insert the actual date of signing on line 16. If there are more than four inventors, please add a copy of this page for identification and signatures for the additional inventors.

DESCRIPTION

COMMUNICATION TERMINAL APPARATUS, BASE STATION
APPARATUS AND RADIO COMMUNICATION METHOD

5 Technical Field

The present invention relates to a communication terminal apparatus, a base station apparatus and a radio communication method.

10 Background Art

A conventional ARQ (Automatic Repeat reQuest) system has three well known systems of "Stop and Wait ARQ (SW-ARQ)", "Go back N ARQ (GBN-ARQ)" and "Selective Repeat ARQ (SR-ARQ)". These three systems have merits
15 that a simple decoder can be employed therein in comparison with an error correction system and high reliability can be obtained and so forth.

In the first place, operation of "SW-ARQ" system is described while employing FIG. 1. A base station
20 transmits one cell (or one packet) to a mobile station. The mobile station checks whether or not an error occurs about the cell in a transmission network. In the case of no error, the mobile station transmits an acknowledge signal (ACK) to the base station while employing a
25 returning channel to inform that the mobile station has received data correctly. While in the case where the mobile station has detected the error, the mobile station

transmits a retransmission request signal (NAK; Negative Acknowledge) of the cell to the base station while canceling the cell with the error. When the base station receives the NAK, the base station retransmits data that is stored in a transmission buffer to the mobile station. Further, the retransmission is continued until the ACK is returned from the mobile station. Thus, since procedure of the "SW-ARQ" system is simple, the "SW-ARQ" system is employed widely for many data transmission.

Further, in the "GBN-ARQ" system, the base station transmits the cell continuously. Then, the base station, as illustrated in FIG. 2, transmits a next cell without waiting a response signal from the mobile station about the cell. Consequently, the base station results in transmitted plural cells until the base station receives the response signal from the mobile station. In an example of FIG. 2, the base station transmits the cells of NO. 1 to NO. 5 until the base station receives the NAK from the mobile station. Further, when the base station receives the NAK from the mobile station, the base station retransmits from a cell (NO. 2 cell) with an error to a cell (NO. 6 cell) which is transmitted in a timing when the NAK is received to the mobile station while going back to a cell corresponding to the NAK stored in the transmitting buffer. The mobile station cancels the cells from NO. 2 to NO. 6 received previously, because

the cells NO. 2 to NO. 6 are retransmitted from the base station.

Moreover, concerning the SR-ARQ system, likewise the GBN-ARQ system, the base station transmits the cell continuously. However, in this system, as illustrated in FIG. 3, the base station retransmits only the cell with occurrence of an error to the mobile station. The SR-ARQ system is one whose transmission efficiency is the most excellent among the above-described three ARQ systems.

Here, in an asymmetrical data transmission, there is a problem that load of a forward channel from the base station to the mobile station becomes large in comparison with a load of a reverse channel from the mobile station to the base station.

In the above-described conventional ARQ system, since retransmission of information data with occurrence of an error in reverse/forward channel is performed while employing the same reverse/forward channel, a problem that load of the forward channel is large in comparison with a load of the reverse channel is not solved.

Disclosure of Invention

An object of the present invention is to provide a communication terminal apparatus, a base station apparatus and a radio communication method capable of performing asymmetrical data transmission with

excellent efficiency while alleviating the load of the forward channel with the large load assigned.

In order to achieve the above-described object, in the present invention, in the case where an error occurs during data transmission in the forward channel, the mobile station returns a received cell as it is while employing the reverse channel. Subsequently, the base station detects an occurrence position of the error while comparing the returned cell with a stored corresponding transmitting cell, followed by informing information indicating the occurrence position of the detected error to the mobile station. Then, the mobile station corrects error data received previously on the basis of the error information.

Namely, in the present invention, since retransmission of the error data that is performed in the forward channel with large load assigned is shifted to the reverse channel, transmission efficiency of asymmetrical data transmission is enhanced.

20

Brief Description of Drawings

FIG. 1 is a sequence view for explaining operation of "Stop and Wait ARQ" of a conventional system;

FIG. 2 is a sequence view for explaining operation of "Go back N ARQ" of a conventional system;

FIG. 3 is a sequence view for explaining operation of "Selective Repeat ARQ" of a conventional system;

FIG. 4 is a configuration view of a radio communication system according to an embodiment 1 of the present invention;

5 FIG. 5A is a sequence view for explaining operation of a base station and a mobile station according to the embodiment 1 of the present invention;

FIG. 5B is a sequence view for explaining operation of a base station and a mobile station according to the embodiment 1 of the present invention;

10 FIG. 6A is a block diagram illustrating a configuration of a transmitting section of the base station according to the embodiment 1 of the present invention;

FIG. 6B is a view illustrating a configuration of
15 a cell transmitted from the base station according to the embodiment 1 of the present invention;

FIG. 7 is a block diagram illustrating a configuration of the mobile station according to the embodiment 1 of the present invention;

20 FIG. 8 is a block diagram illustrating a configuration of a receiving section of the base station according to the embodiment 1 of the present invention.

FIG. 9 is a view illustrating a configuration of error information transmitted from the base station
25 according to the embodiment 1 of the present invention;

FIG. 10 is a block diagram illustrating a configuration of the mobile station according to the

embodiment 1 of the present invention;

FIG. 11A is another sequence view for explaining operation of the base station and the mobile station according to the embodiment 1 of the present invention;

5 FIG. 11B is another sequence view for explaining operation of the base station and the mobile station according to the embodiment 1 of the present invention; and

10 FIG. 12 is a block diagram illustrating a configuration of a mobile station according to an embodiment 2 of the present invention.

Best Mode for Carrying Out the Invention

Embodiments of the present invention are described
15 in detail below with reference to accompanying drawings.

(Embodiment 1)

FIG. 4 is a configuration view of a radio communication system according to an embodiment 1 of the present invention. In FIG. 4, 101 is a transmitting
20 section of a base station side, 102 is a forward user channel (forward Uch), 103 is a forward control channel (forward Cch), 104 is a receiving section of a mobile station side, 105 is a transmitting section of the mobile station side, which performs returning of a cell with
25 an error (hereinafter referred to as error cell) and transmission of ACK/NAK signal, 106 is reverse user channel (reverse Uch), 107 is a reverse control channel

(reverse Cch) and 108 is a receiving section of the base station side.

In the base station which is a transmitting side, a cell is inputted to the transmitting section 101. A
5 CRC (Cyclic Redundancy Check) bit is added to the cell by the transmitting section 101. Subsequently, the cell is transmitted to the mobile station while employing the forward Uch.

Further, the cell is received by the receiving
10 section 104 of the mobile station. The CRC is performed to the received cell by the receiving section 104. Then, in the case of no error, the cell is transferred to a next processing section which is not illustrated by the receiving section 104. On the other hand, in the case
15 where an error occurs on the cell, the cell is transferred to the transmitting section 105 by the receiving section 104, before being returned to the base station as it is by the transmitting section 105 while employing the reverse Uch.

20 In the base station, the receiving section 108 receives an error cell returned from the mobile station. Further, the receiving section 108 detects occurrence position of the error while comparing the received error cell with a corresponding transmitting cell which is
25 stored. Then, the receiving section 108 outputs information (hereinafter referred to as error information) indicating the occurrence position of the

error. Further, the transmitting section 101 transmits the error information to the mobile station while employing the forward Cch. Furthermore, in the case where error occurs on data received by the receiving section 108, the transmitting section 101 requires retransmission to the mobile station while employing the NAK signal.

In the mobile station, the receiving section 104 receives the error information transmitted from the base station. Further, in the case where the error information is received correctly, the receiving section 104 corrects the error data received previously on the basis of a position of an error bit indicated by the error information. On the other hand, in the case where the error information is received incorrectly, the transmitting section 105 requires retransmission of the error information to the base station while employing the NAK signal. Furthermore, concerning transmission of reverse data to the base station from the mobile station, the SR-ARQ system and so forth which are different from the above-described method is adopted.

FIG. 5A and FIG. 5B are sequence views for explaining operation of the base station and the mobile station according to the embodiment 1. As illustrated in FIG. 5A, in the first place, the base station transmits cells to the mobile station in order of the sequence number (SN) order from NO. 1. Since the cells of NO. 2,

3, 4, 5, 7, 8, 9, 10 are transmitted correctly, as illustrated in FIG. 5B, the mobile station returns the ACK signal to the base station while employing the reverse Cch.

5 Since error occurs on the cells of NO. 1 and NO. 6, as illustrated in FIG. 5A, the mobile station returns the NO. 1 cell with the error and the NO. 6 cell with the error as they are to the base station.

 Since the NO. 1 cell is returned correctly, the base
10 station performs error detection while comparing the received NO. 1 cell with a NO. 1 cell which is stored on the occasion of previous transmission. Further, the base station, as illustrated in FIG. 5B, transmits the error information (NO. 1 error information) to the mobile
15 station while employing the forward Cch. On the other hand, since the NO. 6 cell, as illustrated in FIG. 5A, is returned incorrectly, the base station, as illustrated in FIG. 5B, requires such that the mobile station performs returning of the NO. 6 cell again while
20 employing the NAK signal. In compliance with the requirement, the mobile station, as illustrated in FIG. 5A, performs returning of the NO. 6 cell again. Then, since the NO. 6 cell is returned correctly in accordance with the returning performed again, the base station
25 performs error detection while comparing the received NO. 6 cell with a NO. 6 cell which is stored on the occasion of previous transmission. Then, the base station, as

illustrated in FIG. 5B, transmits the error information (NO. 6 error information) to the mobile station while employing the forward Cch.

On the other hand, since the mobile station, as
5 illustrated in FIG. 5B, cannot receive correctly the error information (the NO. 1 error information) of the NO. 1 cell, the mobile station requires retransmission of the error information (the NO. 1 error information) while employing the NAK signal. In compliance with this
10 requirement, the base station, as illustrated in FIG. 5B, retransmits the error information (NO. 1 error information) of the NO. 1 cell.

As illustrated in FIG. 5B, since the error information (NO. 6 error information) of the NO. 6 cell
15 is transmitted correctly, the mobile station corrects the NO. 6 cell with the error received previously on the basis of a position of an error bit indicated by the error information. Further, as illustrated in FIG. 5B, since the error information (NO. 1 error information) of the
20 NO. 1 cell is transmitted correctly due to retransmission of the error information (NO. 1 error information) of the NO. 1 cell, the mobile station corrects the NO. 1 cell with the error received previously on the basis of a position of an error bit indicated by the error
25 information.

According to operation as above, transmission of the cell which is performed while employing the forward

Uch comes to an end with only one time per each cell. Further, on that particular case where an error occurs on the cell transmitted while employing the forward Uch, a returning of the cell with occurrence of the error is performed while employing the reverse Uch with small load assigned. Accordingly, since load of the forward channel with large communication load assigned is reduced, a value of a throughput becomes approximately 100% with a value of E_b/N_0 hardly related.

Further, since there is a little data quantity of the error information transmitted while employing the forward Cch, it is possible to prevent a decrease in the throughput of the forward channel.

Subsequently, a result of an improvement of the throughput of the forward channel in the case where the radio communication system of the present embodiment is employed is indicated in the following table 1. The table 1 is the throughput characteristic of the present embodiment in comparison with the SR-ARQ system. Further, the throughput value of the forward channel of the SR-ARQ system does not contain the cell that is retransmitted to the NAK from the mobile station.

TABLE 1

E_b/N_0	THROUGHPUT CHARACTERISTIC OF FORWARD CHANNEL		IMPROVEMENT OF THROUGHPUT CHARACTERISTIC OF FORWARD CHANNEL	INCREASE OF TRAFFIC OF REVERSE CHANNEL
	SR-ARQ SYSTEM	PRESENT EMBODIMENT		
10 dB	41.9%	ABOUT 100%	58.1 %	MAXIMUM 54.5 % OF FORWARD THROUGHPUT
15 dB	88.4%	ABOUT 100%	11.6 %	MAXIMUM 6.3 % OF FORWARD THROUGHPUT

A following conclusion is obtained from the table 1.

· IMPROVEMENT OF THROUGHPUT CHARACTERISTIC OF FORWARD CHANNEL:

5 58.1 % ($E_b/N_0 = 10\text{dB}$)

· INCREASE OF TRAFFIC OF REVERSE CHANNEL:

MAXIMUM 54.5 % OF FORWARD THROUGHPUT ($E_b/N_0 = 10\text{dB}$)

Next, a configuration and operation of the transmitting section 101 of the base station side will be described specifically. FIG. 6A is a block diagram illustrating a configuration of the transmitting section 101 of the base station. In FIG. 6A, 301 is a data input section, 302 is a header adding section, 303 is a CRC adding section, 304 is a SN adding section and 305 is a data transmitting section.

In the header adding section 302, an ATM (Asynchronous Transfer Mode) cell header and a radio header are added to information data inputted to the data

input section 301, followed by adding the CRC bit in the CRC adding section 303. In the SN adding section 304, a sequence number SN for warranting turn of the data is added to the information data as header control
5 information, before being built into one cell. FIG. 6B illustrates the configuration of the built cell. The built cell is transmitted to the mobile station from the data transmitting section 305 while employing the forward Uch. Transmission of the cell with the forward
10 Uch employed is performed only one time per one cell regardless of existence of an error. Accordingly, it is possible to reduce a communication load of the forward channel.

Next, a configuration and operation of the mobile
15 station side will be described specifically. FIG. 7 is a block diagram illustrating a configuration of the mobile station. However, in FIG. 7, the same number is added to the same configuration as that of FIG. 4 to omit the description.

20 In FIG. 7, the receiving section 104 includes a data receiving section 404 and a CRC section 405. Further, the transmitting section 105 includes an ACK returning section 401, an error cell returning section 402, and a CRC renewal processing section 403.

25 Concerning the cell received by the data receiving section 404, in the first place, an error check is performed in the CRC section 405. The CRC section 405

performs error checking with respect to the cell in accordance with predetermined CRC method.

Further, in the case of no error on the cell, the CRC section 405 outputs a received cell to next processing section which is not illustrated. Then, an acknowledge signal ACK is replied to the base station by the ACK returning section 401 while employing reverse Cch.

On the other hand, in the case where an error exists, a CRC bit is added to a data portion of the received cell newly by the CRC renewal processing section 403. Then, an error cell is returned to the base station as it is by the error cell returning section 402 while employing the reverse Uch.

Thus, in the case where an error occurs on the cell on the occasion of transmission in the forward channel, since retransmission of the error cell is performed while employing the reverse channel with light load assigned, it is possible to reduce communication load of the forward channel. Further, the worse is the state of affairs of the forward propagation path, the larger is the improvement effect.

Next, a configuration and operation of the receiving section 108 of the base station side will be described specifically. FIG. 8 is a block diagram illustrating a configuration of the receiving section 108 of the base station side. However, in FIG. 8, the same number is added to the same configuration as that

of FIG. 4 to omit the description.

In FIG. 8, 501 is a data receiving section, 502 is a CRC section, 503 is a retransmission requiring section, 504 is an error detecting section, 505 is a buffer for storing transmission data, 506 is a retransmission processing section and 507 is an error information processing section.

An error cell returned from the mobile station is received by the data receiving section 501. Then, the CRC section 502 performs CRC to the error cell. In the case where the error cell cannot be received correctly (namely, a result of the CRC becomes NG), the retransmission requiring section 503 requires retransmission of the error cell to the mobile station while employing the NAK signal. On the other hand, in the case where the error cell is received correctly (namely, a result of the CRC becomes OK), the error detecting section 504 compares the received error cell with a corresponding cell stored in the buffer 505 on the occasion of previous transmission, followed by detecting an occurrence position of the error and the number of occurrence of the error.

In the case where the number of occurrence of the error is smaller than the predetermined number, the error information processor 507 generates error information. Then, the transmitting section 101 transmits the error information to the mobile station while employing the

forward Cch.

FIG. 9 illustrates a configuration of the error information. In FIG. 9, 601 is an occurrence position of an error bit, 602 is a sequence number SN and 603 is a CRC bit. The error information configured as above is transmitted to the mobile station while employing the forward Cch. The mobile station can find an occurrence position of the error within the error cell due to the occurrence position 601 of the error bit. Further, the mobile station can find whether the error information is one that is related to which cell due to the SN 602. Furthermore, the CRC bit 603 is employed for checking existence of the error that occurs during transmission of the error information in the mobile station. In the case where the error information takes such configuration, the error information requires 9 bits per one error.

Thus, in the case where the number of occurrence of the error is smaller than the predetermined number, since the error information with small data quantity is transmitted while employing the forward Cch, it is possible to reduce the communication load of the forward Uch.

On the other hand, in the case where the number of occurrence of the error is more than the predetermined number (for instance, the number of bits of the error information is quantity of more than corresponding one

cell), the retransmission processing section 506 instructs to the data input section 301 so as to perform retransmission of the cell in stead of the fact that the error information is transmitted to the mobile station.

5 In this case, the data input section 301 extracts a cell corresponding to the error cell from the buffer 505, followed by retransmitting the corresponding cell to the mobile station while employing the forward Uch. The mobile station rewrites the cell with the same SN due

10 to a cell received newly.

Thus, in the case where the number of occurrence of the error is more than the predetermined number, namely, in the case where the number of occurrence of the error is exceedingly large, since retransmission of the error

15 cell is performed while employing the forward Uch, it is possible to improve utilization efficiency of channel of the whole system. Further, since a probability that the number of occurrence of the error is extremely large is extremely small, there is a few decrease of the

20 throughput of the forward channel due to retransmission of the cell in comparison with the state where the number of occurrence of the error is small.

Next, operation of the mobile station will be described in the case where the mobile station receives

25 the error information from the base station. FIG. 10 is a block diagram illustrating a configuration of the mobile station according to the embodiment 1 for

performing correction of the error cell in accordance with the error information. However, in FIG. 10, the same number is added to the same configuration as that of FIG. 4 as well as FIG. 7 to omit the description.

5 In FIG. 10, 701 is an error correcting section, 702 is a data receiving buffer and 703 is a NAK returning section. The error information transmitted from the base station is received by the data receiving section 404, followed by performing an error check in the CRC
10 section 405.

 In a result of the error check, in the case where there is no error in the error information, the error correcting section 701 causes the error bit of corresponding error cell stored in the data receiving
15 buffer 702 to be inverted in accordance with a position of the error bit indicated by the error information to correct the error of the error cell. Then, the error correcting section 701 outputs the corrected cell to a next processing section which is not illustrated.

20 In a result of the error check, in the case where the error exists in the error information, the NAK returning section 703 transmits the NAK signal to the base station to require retransmission of the error information to the base station.

25 FIG. 11A and FIG. 11B are another sequence views for explaining operation of the base station and the mobile station according to the embodiment 1. As

illustrated in FIG. 11A, in the first place, the base station transmits the cell to the mobile station in turn from NO. 1, in SN order. Since the cells of NO. 2, 3, 4, 5, 7, 8, 9 are transmitted correctly, as illustrated in FIG. 11B, the mobile station returns the ACK signal to the base station while employing the reverse Cch.

Since the error occurs in the cells of NO. 1 and NO. 6, as illustrated in FIG. 11A, the mobile station returns the NO. 1 cell with the error and the NO. 6 cell with the error to the base station as they are while employing the reverse Uch.

Since both of the NO. 1 cell and the NO. 6 cell are returned correctly, the base station compares the received NO. 1 cell and NO. 6 cell with the NO. 1 cell and the NO. 6 cell stored on the occasion of previous transmission respectively, followed by performing detection of the error. Here, for instance, in the case where the number of occurrence of the error in the NO. 1 cell is smaller than the predetermined number, as illustrated in FIG. 11B, the base station transmits error information (NO. 1 error information) indicating occurrence position of an error to the mobile station while employing the forward Cch. Further, for instance, in the case where the number of occurrence of the error in the NO. 6 is more than the predetermined number, namely in the case where the number of occurrence of the error is extremely large, as illustrated in FIG. 11A, the base

station performs retransmission of the NO. 6 cell while employing the forward Uch in stead of transmission of the error information.

Then, since the retransmitted NO. 6 cell is
5 transmitted correctly, the mobile station, as
illustrated in FIG. 11B, returns the ACK signal to the
base station. Moreover, since the error information (NO.
1 error information) of the NO. 1 cell is not transmitted
correctly, the mobile station requires retransmission
10 of the error information (NO. 1 error information) to
the base station while employing the NAK signal. In
compliance with this requirement, the base station, as
illustrated in FIG. 11B, retransmits the error
information (NO. 1 error information) of the NO. 1 cell
15 to the mobile station.

Then, since the retransmitted error information (NO.
1 error information) of the NO. 1 cell is transmitted
correctly, the mobile station corrects the NO. 1 cell
with the error received previously on the basis of a
20 position of the error bit indicated by the error
information.

As described above, according to the present
embodiment, it is possible to decrease communication
load of the forward channel with large communication load
25 assigned.

(Embodiment 2)

FIG. 12 is a block diagram illustrating a configuration of the mobile station according to an embodiment 2 of the present invention. Further, in FIG. 12, the same number is added to the same configuration as that of FIG. 4 and FIG. 7 to omit the description.

In FIG. 12, 901 is a returning section, 902 is a returning buffer, 903 is a CRC adding section, 904 is a reverse transmission buffer and 905 is a data transmitting section. Concerning a cell received by the data receiving section 404, in the first place, an error check is performed in the CRC section 405. In the case where an error exists, the returning section 901 performs returning processing. The cell results in a condition for waiting transmission in the returning buffer 902.

On the other hand, data transmitted from the mobile station, to which the CRC bit is added in the CRC adding section 903, results in a condition for waiting transmission in the reverse transmitting buffer 904.

The data transmitting section 905 refers to the reverse transmitting buffer 904 on the occasion of transmission of the data. The data transmitting section 905, in the case where transmitted information data is stored in the reverse transmitting buffer 904, transmits the information data stored in the reverse transmitting buffer 904 while taking precedence over returning of the cell with an error stored in the returning buffer 902. Then, when the information data stored in the reverse

transmitting buffer 904 is over, the data transmitting section 905 returns the error cell stored in the returning buffer 902.

As described above, according to the present
5 embodiment, since returning of the error cell is performed only in the case where there is room in a traffic of the reverse Uch, it is possible to return the error cell without influencing transmission of the information data.

10 Further, in the embodiment 1 and the embodiment 2, as one example, there is described on the assumption that the ATM cell form is employed as the form of the information data. However, the form of the employed information data is not limited to the ATM cell form.
15 It does not matter whether the form of the information is a packet or so forth.

As described above, according to the present invention, transmission of the cell performed while employing the forward Uch ends by only one time per each
20 cell. Further, returning of the cell with the error occurrence is performed while employing the reverse Uch with small load assigned on that particular case where an error occurs in the cell transmitted while employing the forward Uch. Consequently, according to the present
25 invention, since the throughput becomes about 100% in the context with a value of E_b/N_0 hardly related, the load of the forward channel whose communication load is large

is reduced.

Further, according to the present invention, since the error information transmitted while employing the forward Cch has a small amount of data quantity, it is possible to prevent decrease of the throughput of the forward channel.

Consequently, according to the present invention, since it is possible to alleviate load of the forward channel with large load assigned, it is possible to perform asymmetrical data transmission with excellent efficiency .

This application is based on the Japanese Patent Application No. HEI 11-94351 filed on March 31, 1999 and the Japanese Patent Application No. HEI 11-102734 filed on April 9, 1999, entire contents of which are expressly incorporated by reference herein.

Industrial Applicability

The present invention is applicable to a base station apparatus that is employed in a radio communication system, and to a communication terminal apparatus such as a mobile station for performing radio communication to the base station apparatus.

CLAIMS

1. A communication terminal apparatus comprising:
an error checker for checking whether or not an
error exists in a unit of transmission that is received ;
5 returner for returning the unit of transmission
with an error detected; and

corrector for correcting the error of the unit of
transmission with the error detected on the basis of error
information which is received after reception of the unit
10 of transmission with the error detected.

2. A communication terminal apparatus according to
claim 1, wherein the corrector corrects the error on the
basis of information indicating a position of an error
bit.

15 3. A communication terminal apparatus according to
claim 1, wherein the corrector causes the error bit to
be inverted so as to correct the error.

4. A communication terminal apparatus according to
claim 1, wherein the error checker checks existence of
20 an error of the unit of transmission due to CRC.

5. A communication terminal apparatus according to
claim 1, wherein the returner adds a CRC bit to the unit
of transmission with the error detected to return.

6. A communication terminal apparatus according to
25 claim 1, wherein the returner stores the unit of
transmission with the error detected, followed by
returning the stored unit of transmission only when there

is no unit of transmission further.

7. A base station apparatus comprising:

a transmitter for transmitting a generated unit of transmission and for storing the generated unit of transmission in a buffer;

a detector for detecting an error within the unit of transmission while comparing a unit of transmission returned from the communication terminal apparatus according to claim 1 with a unit of transmission stored in the buffer; and

an error information generator for generating information regarding the error.

8. A base station apparatus according to claim 7, further comprising a retransmitter for retransmitting the unit of transmission stored in the buffer in the case where the number of the errors existing within the unit of transmission is not less than a predetermined threshold value.

9. A radio communication method comprising:

retransmitting a unit of transmission with an error detected from a communication terminal apparatus;

generating information regarding an error within the unit of transmission while comparing a returned unit of transmission with a corresponding unit of transmission stored in a buffer previous to transmission of the unit of transmission in a base station apparatus, followed by transmitting the information to the

communication terminal apparatus from the base station apparatus; and

correcting the error on the unit of transmission on the basis of the information in the communication
5 terminal apparatus.

ABSTRACT

A communication terminal apparatus returns a unit of transmission with an error detected. A base station apparatus generates information indicating a position of an error within the unit of transmission while
5 comparing a unit of transmission returned from the communication terminal apparatus with a corresponding unit of transmission stored in a buffer previous to transmission of the unit of transmission. The base
10 station apparatus transmits the generated information to the communication terminal apparatus. The communication terminal apparatus corrects the error of the unit of transmission on the basis of the information.

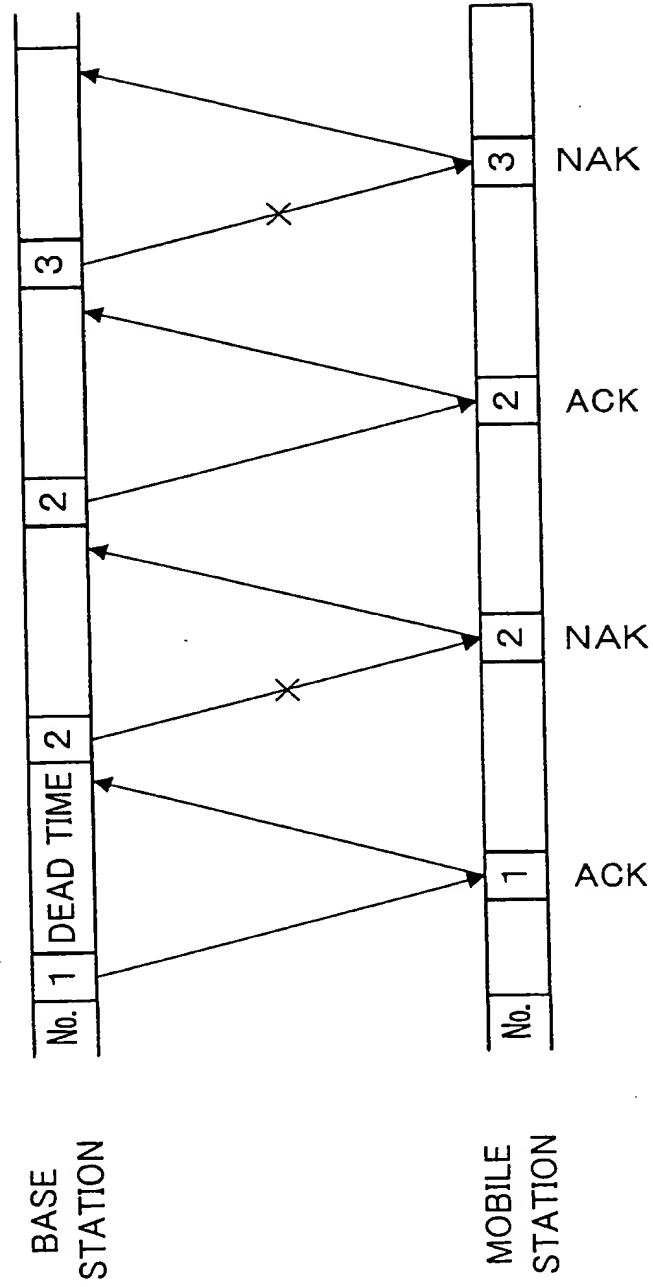


FIG.1

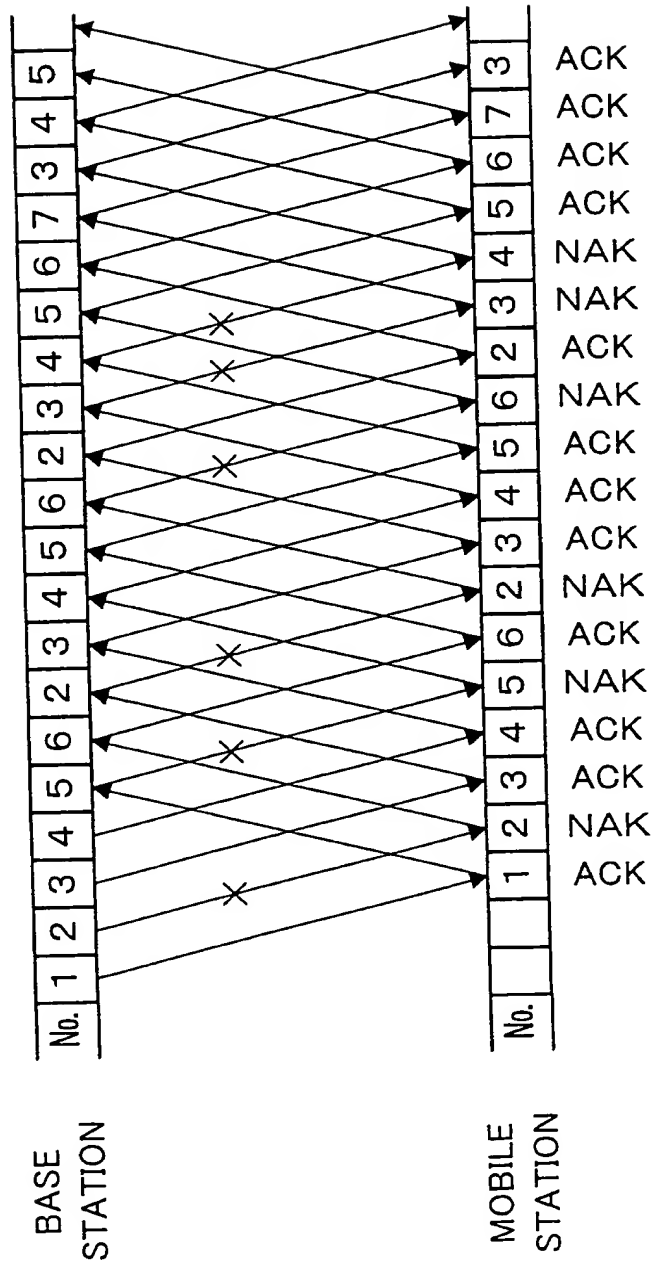


FIG.2

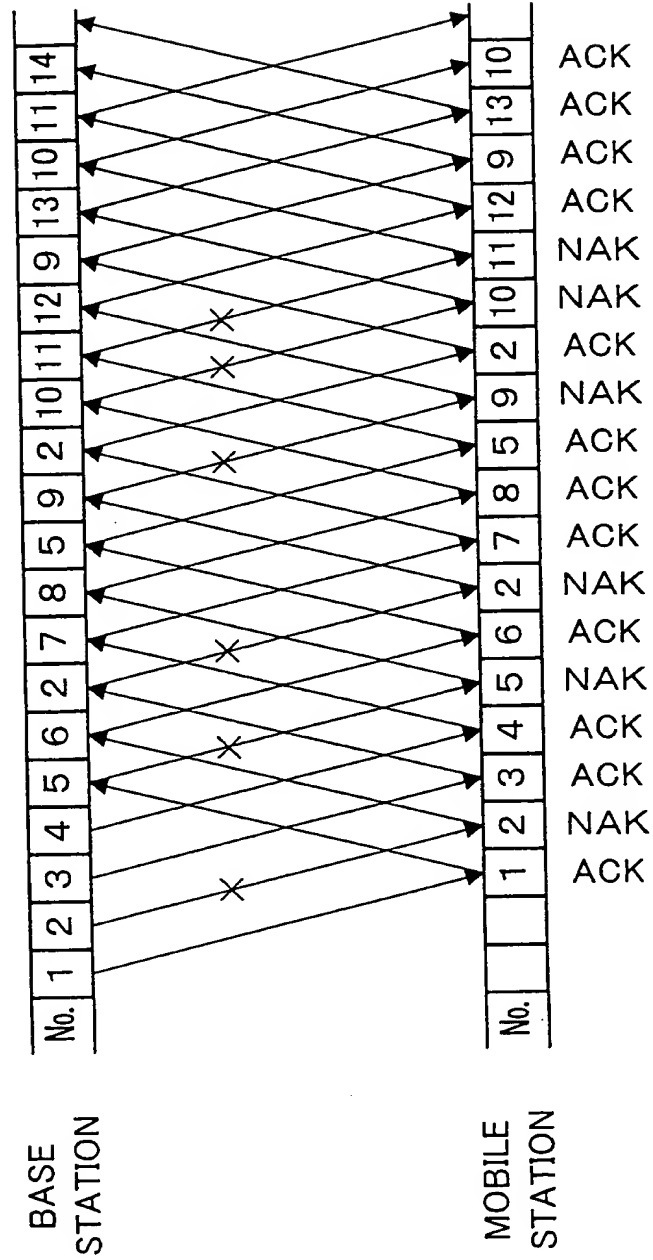


FIG.3

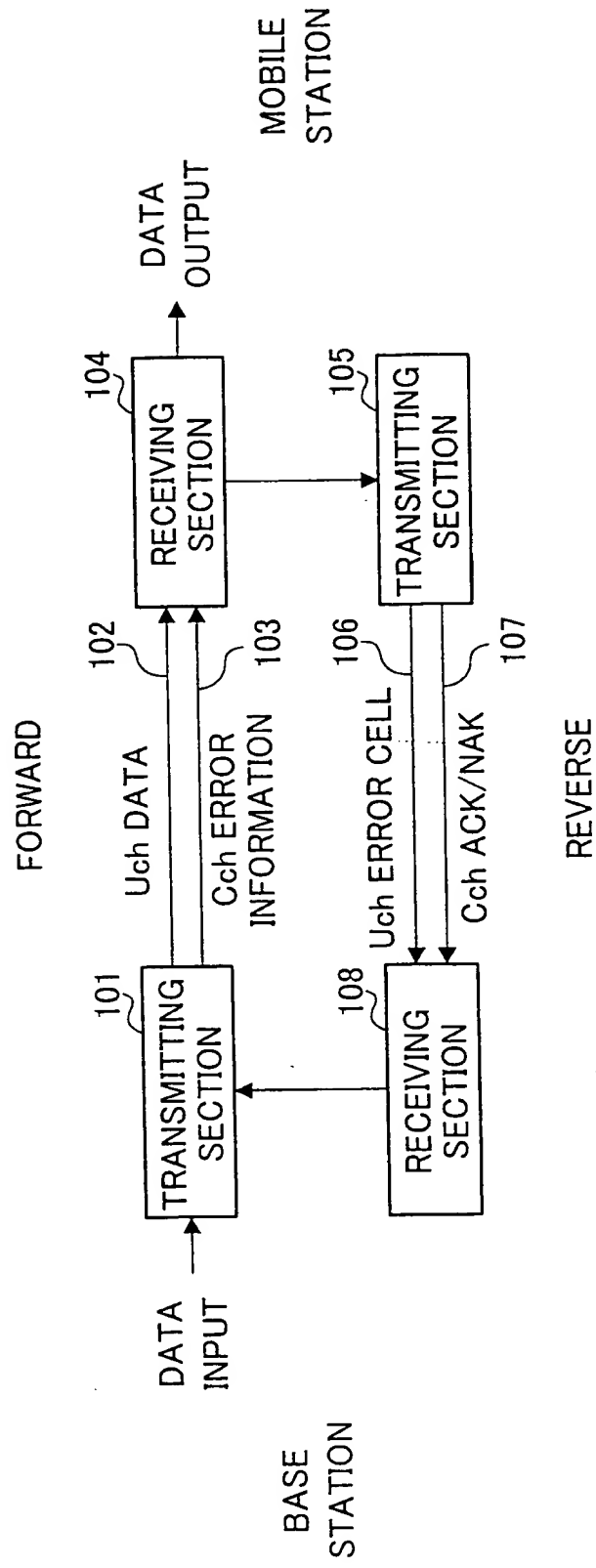


FIG.4

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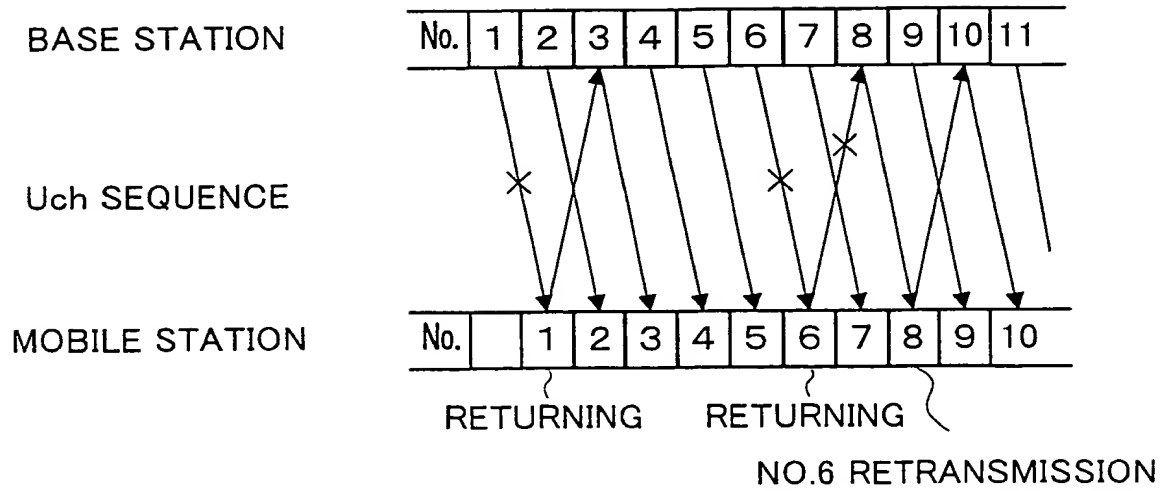


FIG.5A

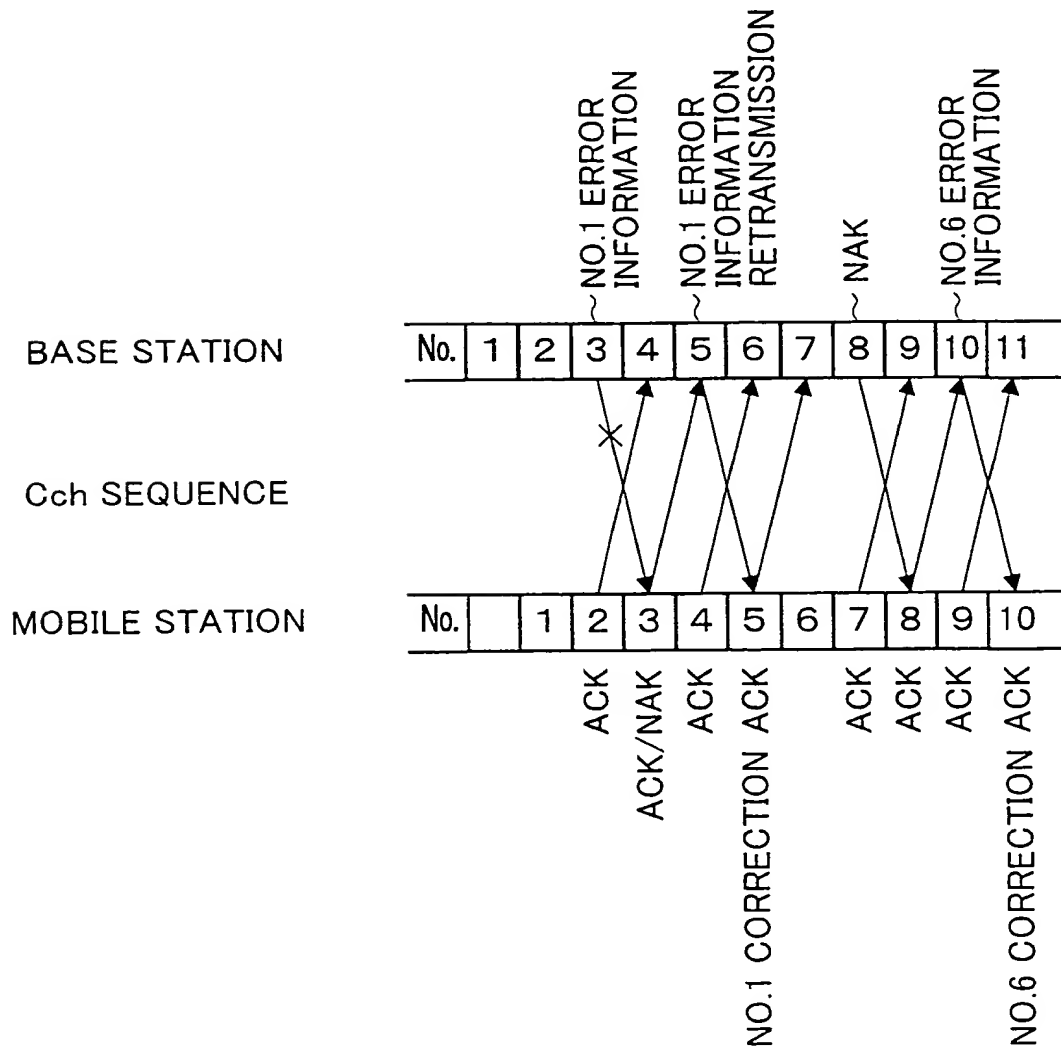


FIG.5B

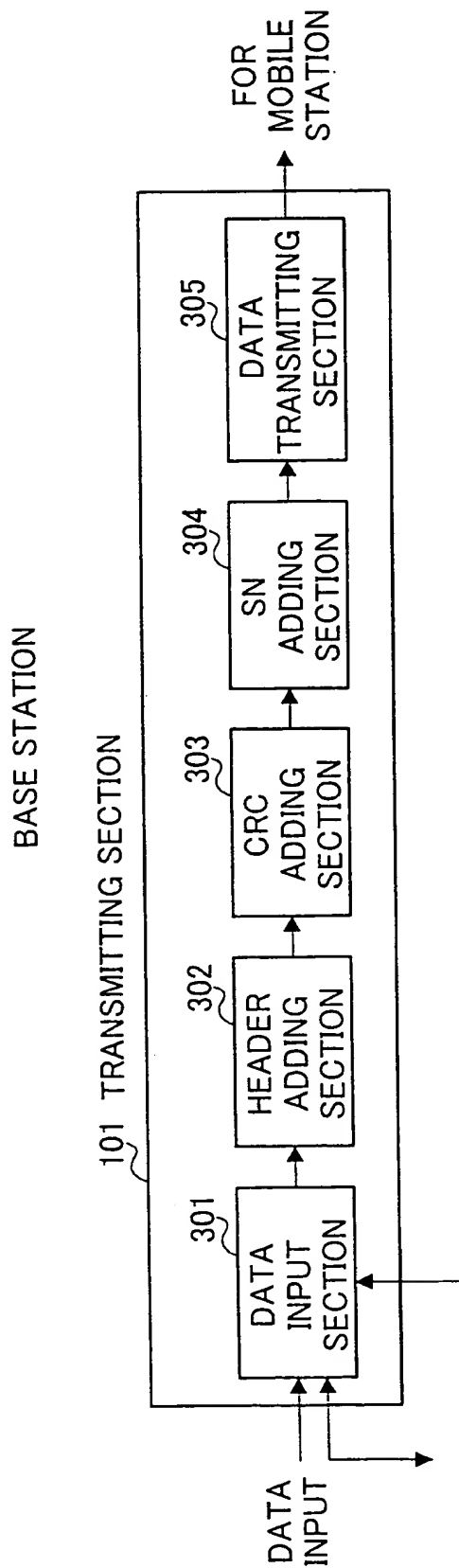


FIG.6A

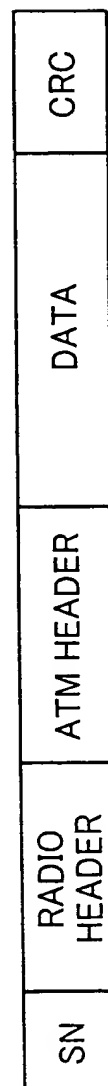


FIG.6B

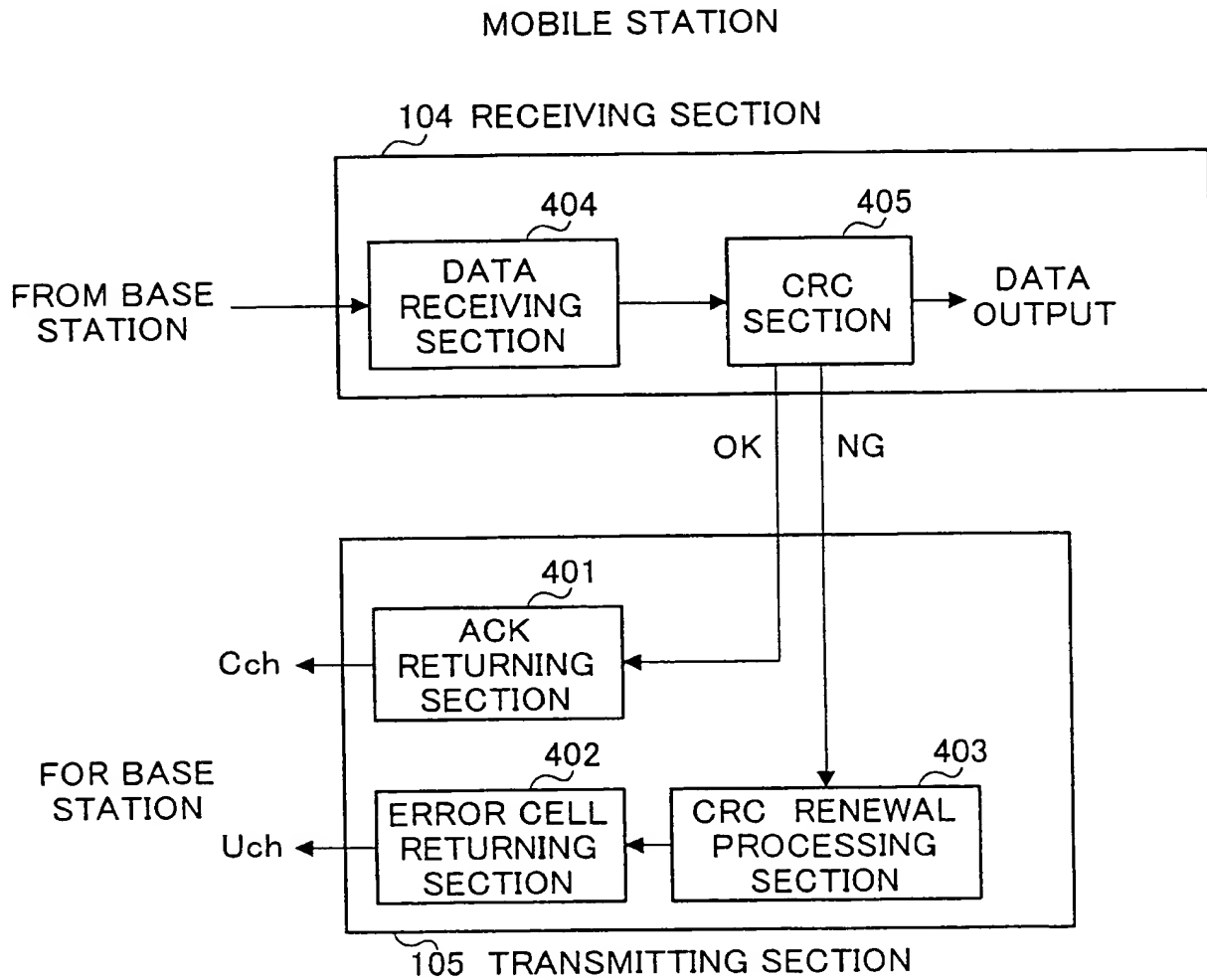
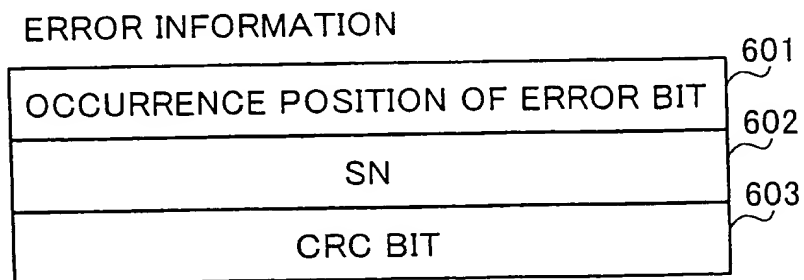
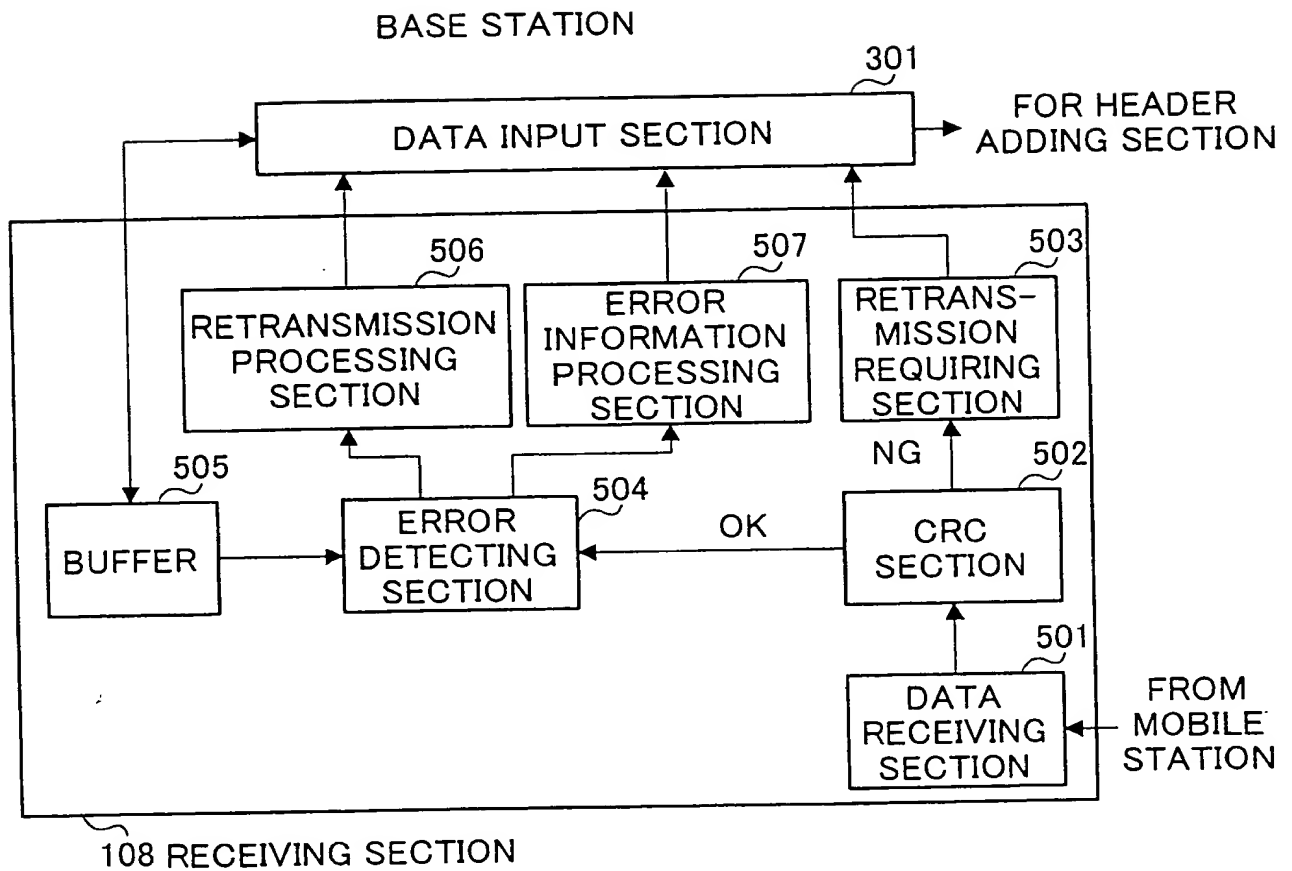


FIG.7



MOBILE STATION

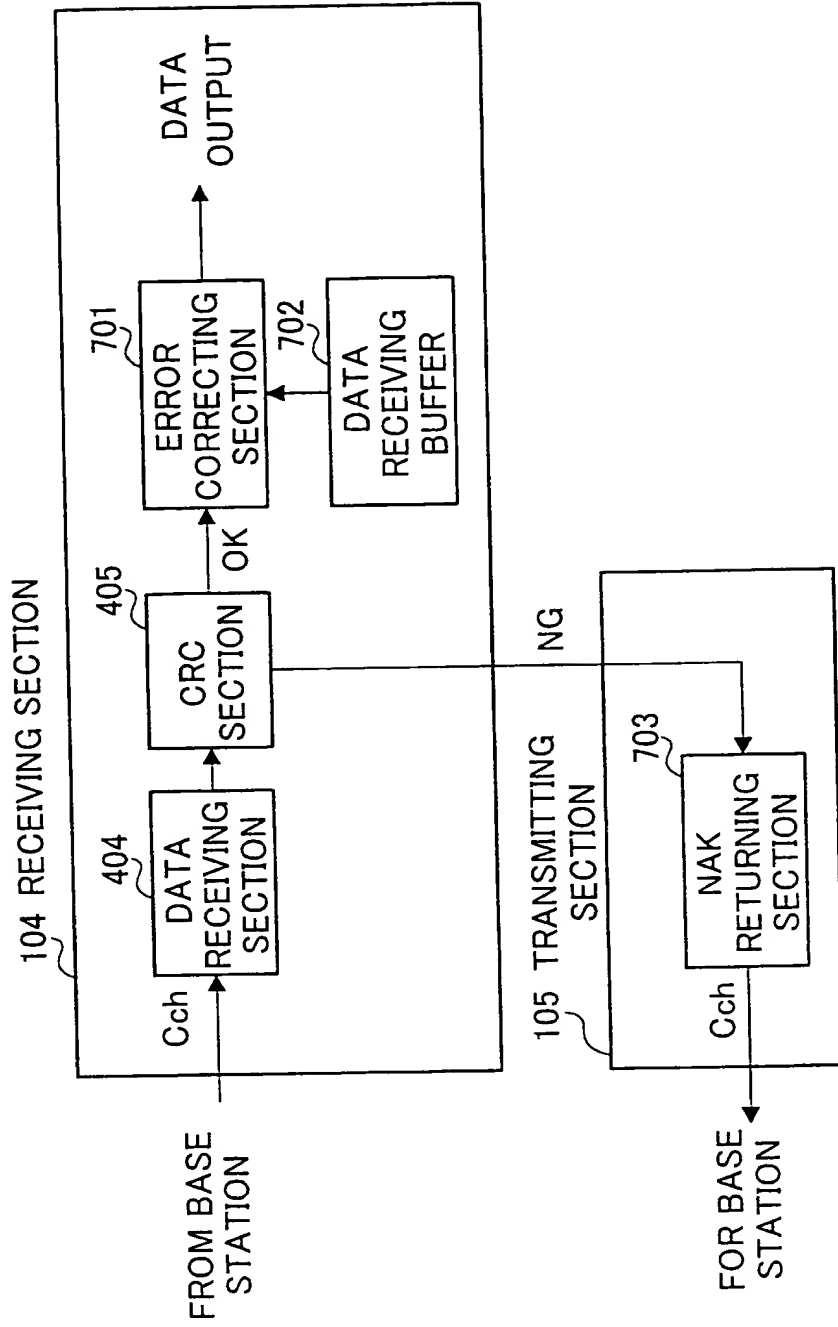


FIG.10

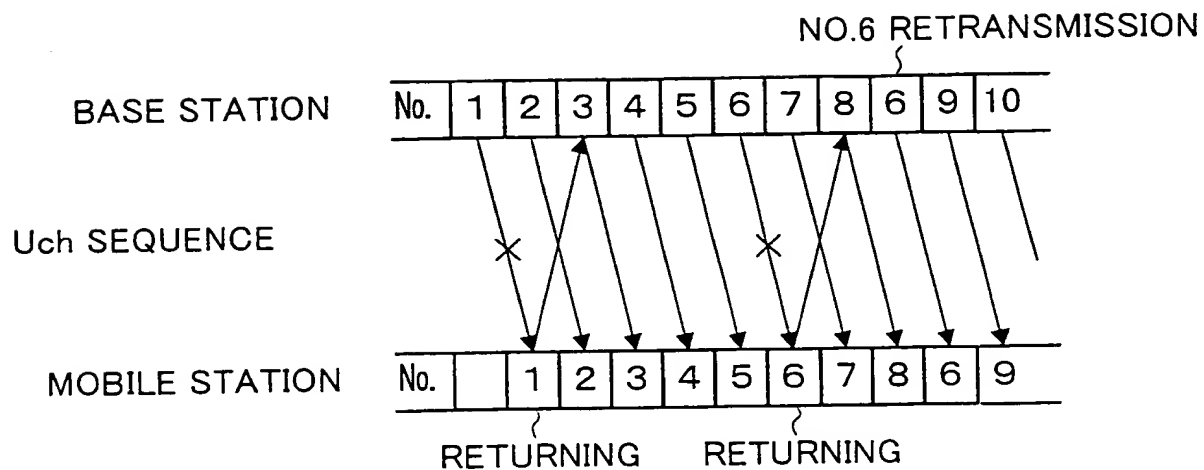


FIG.11A

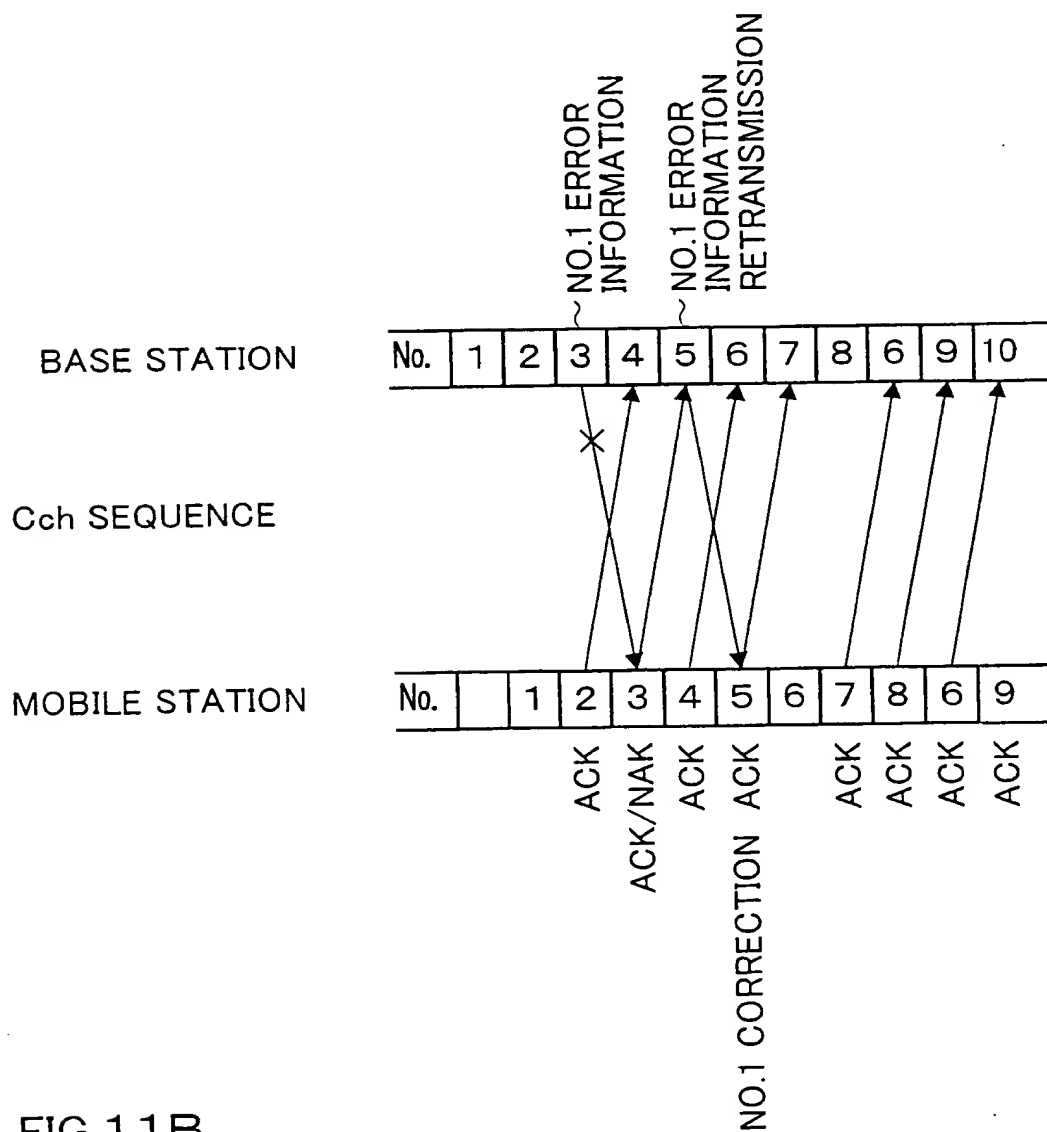


FIG.11B

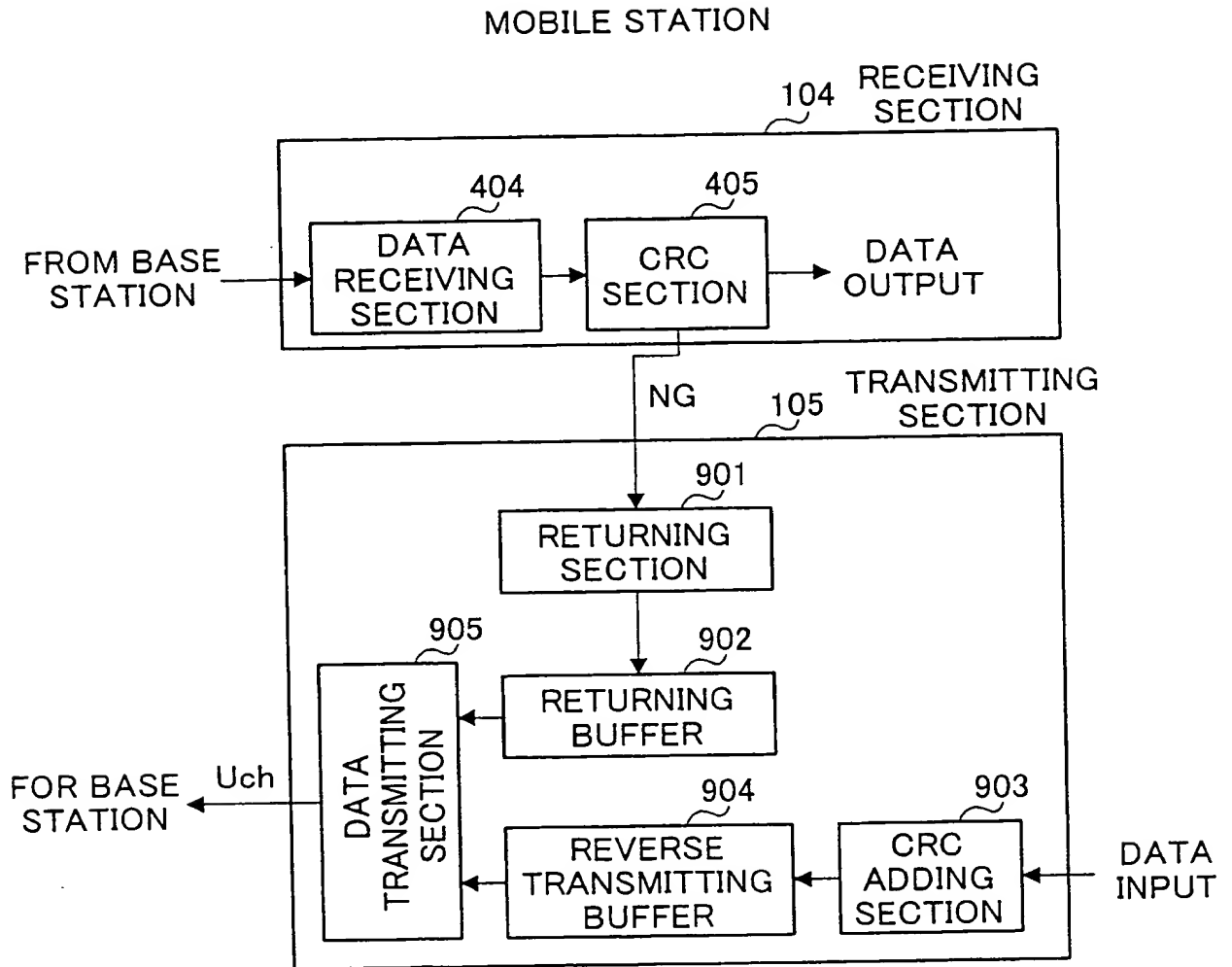


FIG. 12